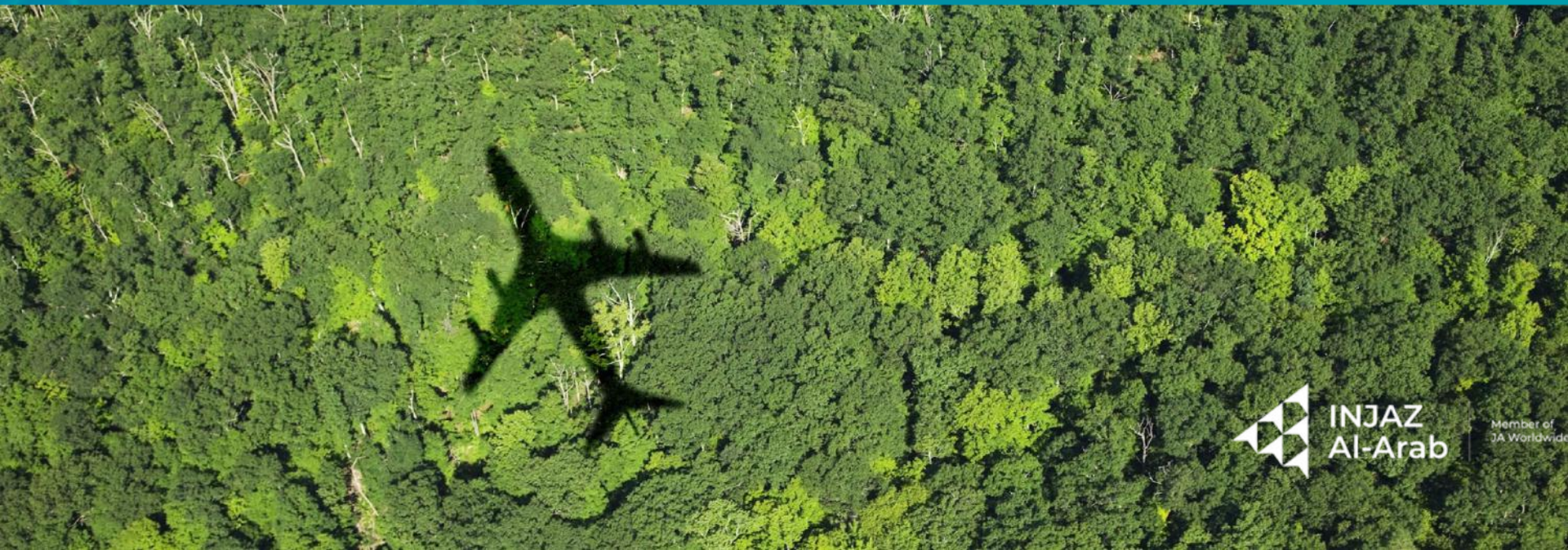
ONWARD & UPWARD:

Navigating the Future of Sustainability in Aviation

INJAZ Al-Arab

Member of JA Worldwide

Module 2:
Sustainable Aviation Practices



Look out for:

General Knowledge & Insightful Facts

Key Things to Note

Self- paced Learning Activity

Required Tasks

INJAZ Al-Arab

Member of JA Worldwide

Module 2: Objectives & Learning Outcomes

Objectives

- **2.1:** Defining sustainable aviation practices and technologies
- **2.2:** Exploring real life (RL) examples of sustainable aviation in action
- **2.3:** Introducing innovative sustainability ideas

Learning Outcomes

- **2.a:** Recognize the importance of integrating sustainability into aviation operations for long-term industry resilience
- **2.b:** Identify practical challenges and benefits of sustainable practices
- **2.c:** Cultivate a mindset of creativity and adaptability

Write down and set your learning intentions for this module. Ask yourself what do you want to learn and why?

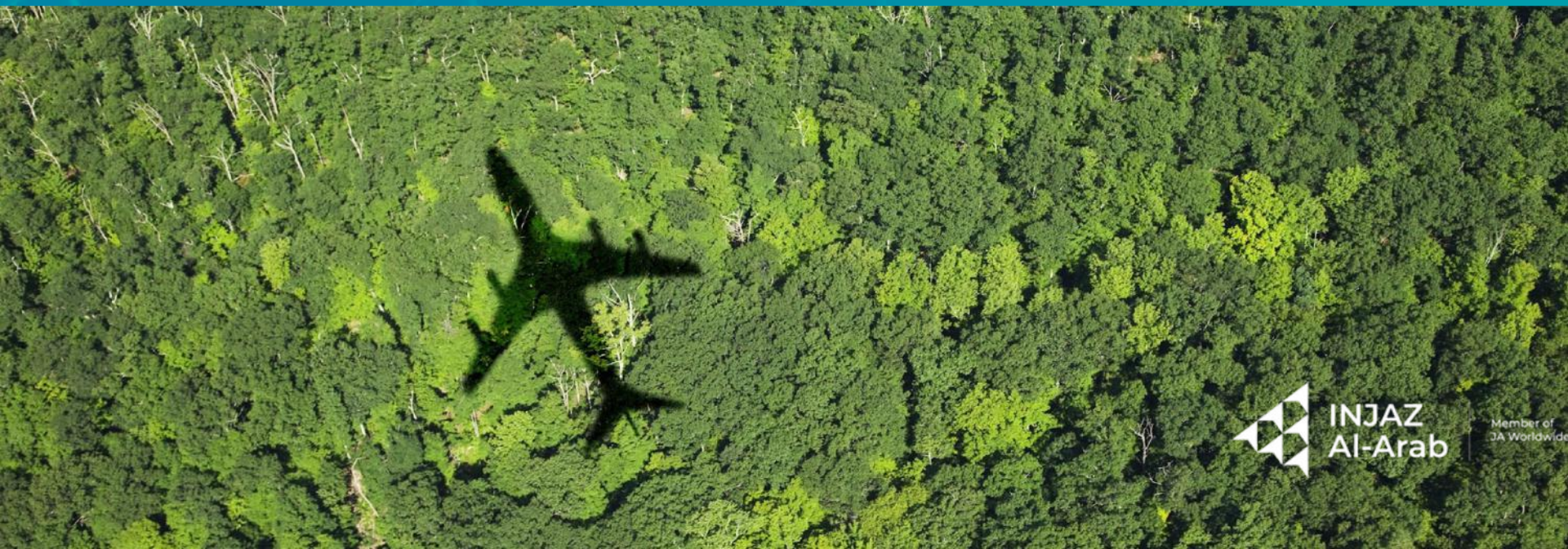
DO

Skills: Drive change and innovation, breaking orthodoxies, structured problem-solving, creativity and imagination

INJAZ Al-Arab

Member of JA Worldwide

Objective 2.1:
Sustainable Aviation Practices & Technologies



Aviation & the Environment: *Refresher* (Module 1)

Key Stakeholders: Global Air Transport System


Manufacturers


Tourism Community


Ground Support Operations


Regulatory Bodies


Passengers


Airlines


Business Community


Airports & Airspace Operators

Aviation Environmental Impact

GHGs & Climate Change


Energy & Resources


Aircraft Noise Pollution


Waste


Air pollution

DO

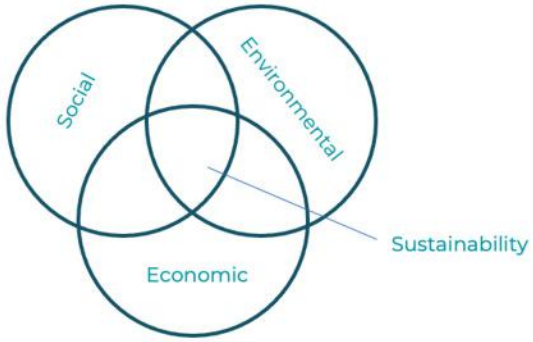
For each environmental impact, list 2 examples that any of the key stakeholders would be responsible for.

INJAZ Al-Arab

Member of JA Worldwide

Sustainable Aviation Practices:
Guiding Concepts

Triple Bottom Line Sustainability



Cradle-to-cradle Practices

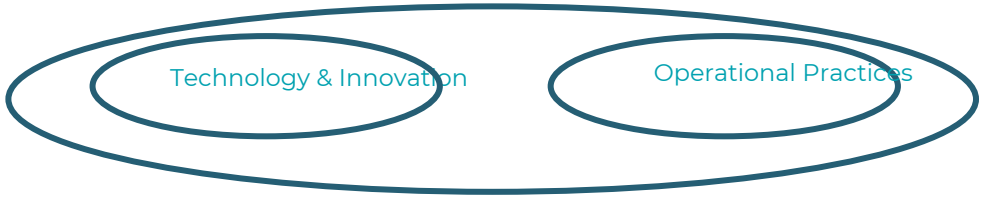
Interdependency of Sustainable Aviation Solutions

Source: NREL

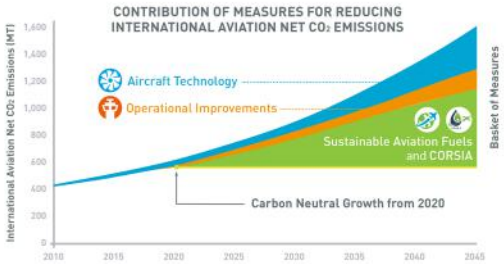
INJAZ Al-Arab
Member of JA Worldwide

Sustainable Aviation:
Environmental Stewardship

Legislation



- Aircraft design & technologies
- Sustainable Aviation Fuels (SAFs)
- Eco-friendly airport designs & infrastructure
- Optimized flight paths
- Waste management and mitigation
- Noise reduction measures



Source: ICAO

Industry Collaborations:

IATA, Heathrow, SKYNRG, ICAO, ATAG Air Transport Action Group, AIRBUS, Schiphol, EASA European Union Aviation Safety Agency, QATAR Airways, KLM Royal Dutch Airlines

DO

How do performance metrics guide decision-making and accountability in efforts to meet set goals? Discuss with your fellows.

INJAZ Al-Arab

Member of JA Worldwide

Sustainable Aviation:
Technologies

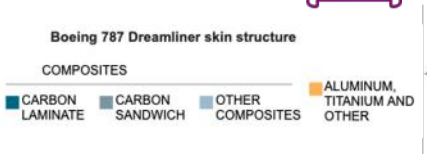
Propulsion:

360 Engine foam wash, reduces emissions and improves exiting efficiency (Source: General Electric)

LEAP energy efficient Engine, 15% more efficient than previous generations (Source: CFM)

Airbus E-Fan X electric powered engines and aircraft (Source: Airbus)

Aircraft Design:



Composite lightweight materials (Source: NY Times)

Source: ABBB

Winglet devices to improve aerodynamics (biomimicry) (Source: ABBB)

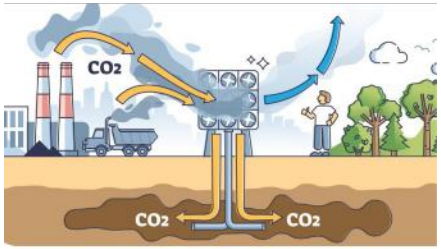
INJAZ Al-Arab
Member of JA Worldwide

Sustainable Aviation:
Technologies

Carbon Capture:

CO_2 ↓

Carbon capture plants (Source: ISC)



Carbon capture cycle (co_2 atmosphere capture & storage) (Source: Green Recruitment Company)

Airport Architecture Innovation:

Green airport architecture changi airport (Source: Mercator Airport- World)

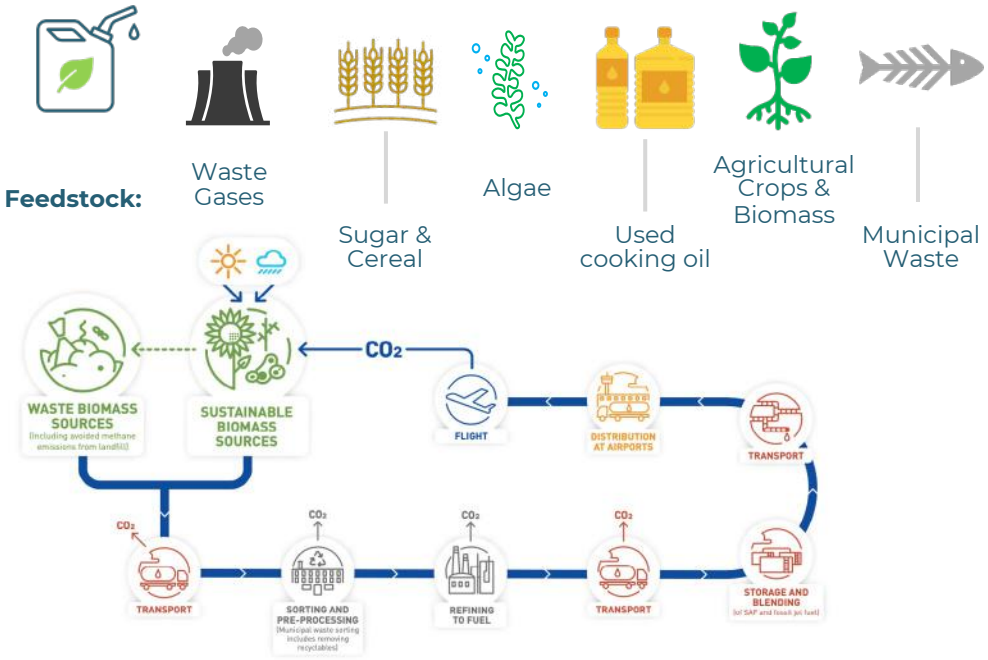
PV Solar panels & energy saving measures in airports (Source: Solar Tribune)

INJAZ Al-Arab | Member of JA Worldwide

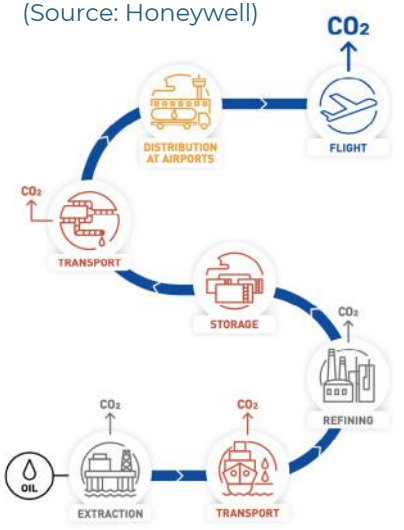
Sustainable Aviation: *Technologies*

Sustainable Aviation Biofuel
(Source: Honeywell)

Sustainable Aviation Fuels:



SAF Carbon Lifecycle (Source: ATAG)

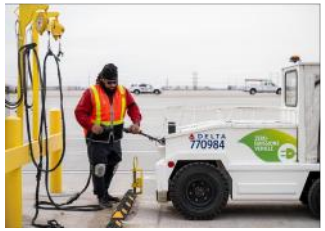


Fossil Fuels Carbon Lifecycle
(Source: ATAG)

INJAZ Al-Arab
Member of JA Worldwide

Sustainable Aviation:
Operational Practices

Airport Energy & Resource Conservation:



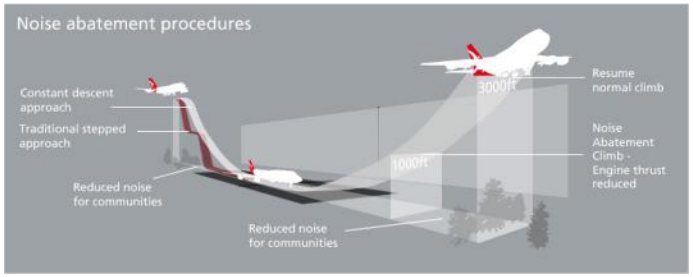
Electric ground support equipment (GSE)
(Source: Delta)

LED airport lighting
(Source: ENELTEC)

Window tinting minimising cooling loss
(Source: DTE)

Automatic water saving faucets
(Source: Stern Faucets)

Noise Abatement:



Optimised flight paths (Source: Infinite Flight)

Noise- reducing landscape & panels
(Source: WLA)

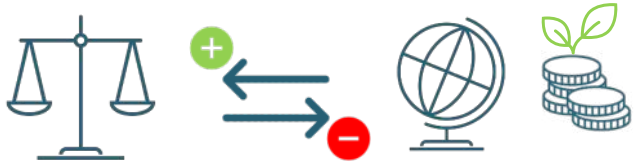
INJAZ Al-Arab
Member of JA Worldwide

Sustainable Aviation:
Operational Practices

Carbon Offsetting:

CO_2 ↓

Tree planting to offset aviation carbon emissions (Source: BBC)



Emission trading schemes; high carbon producing countries trade with low carbon producing countries to offset and balance global emissions, eg. **CORSIA, UK-ETS**

Aircraft Manufacturing Waste Mitigation:

Aircraft dismantling material recovery (Source: Asahi)

Aircraft end of life disassembly, material and components recovery and recycling (Source: Airbus)

INJAZ Al-Arab

Member of JA Worldwide

Sustainable Aviation:
Operational Practices

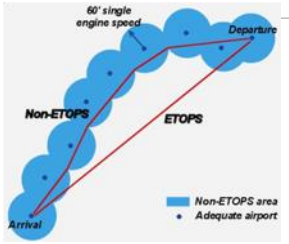
Airport and Airline Operational Waste Mitigation:

Water dispensing stations (Source: Smart Water Magazine)

Waste sorting bins for recycling (Source: Ferrovial)

Onboard waste collection for recycling (Source: Travel Codex)

Flight Operations and Path Optimization:



Flight path optimization reducing fuel consumption (Source: IVAO)

Follow the greens airfield lighting reducing taxiing fuel consumption (Source: TM3 Airports)

Electrical power of aircrafts at gates (Source: Schipol)

Night flight restrictions to reduce noise

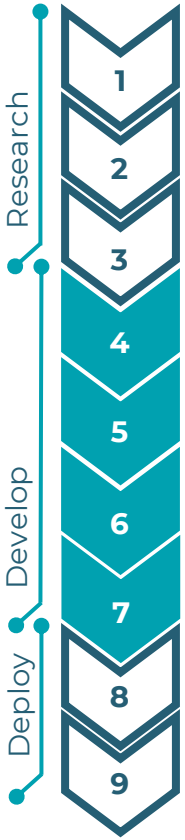
INJAZ Al-Arab

Member of JA Worldwide

Sustainable Aviation:
Industry Constraints

- **Regulatory Frameworks**
- **Infrastructure Limitations**
- **Market Dynamics**
- **Technological Readiness**
- **Financial Implications**

Technology Readiness Levels (TRL)

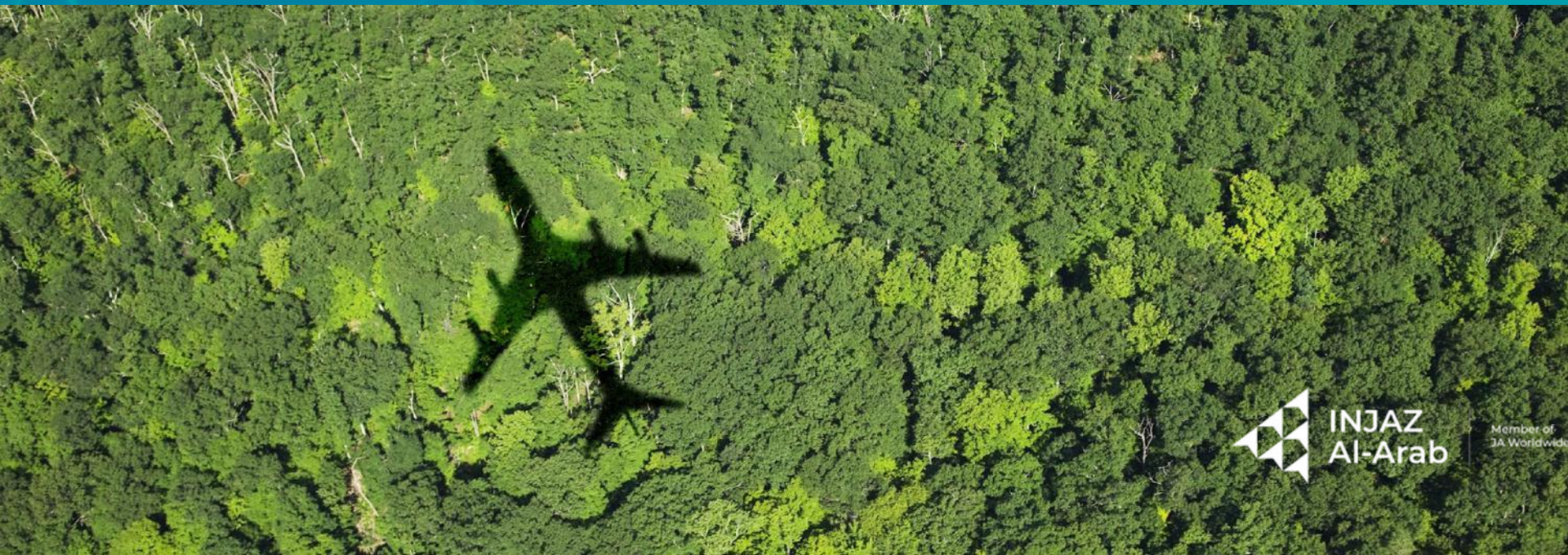


1. Observation of basic principles
2. Concept developing and testing
3. Proof of concept
4. Technology validation in lab
5. Technology validation in operation
6. Technology demonstration in operation
7. System demonstration in real world
8. System complete and qualified
9. Actual proof of real- world system operation

INJAZ Al-Arab
Member of JA Worldwide

Objective 2.2:

Case Studies of Sustainability Initiatives Implementation

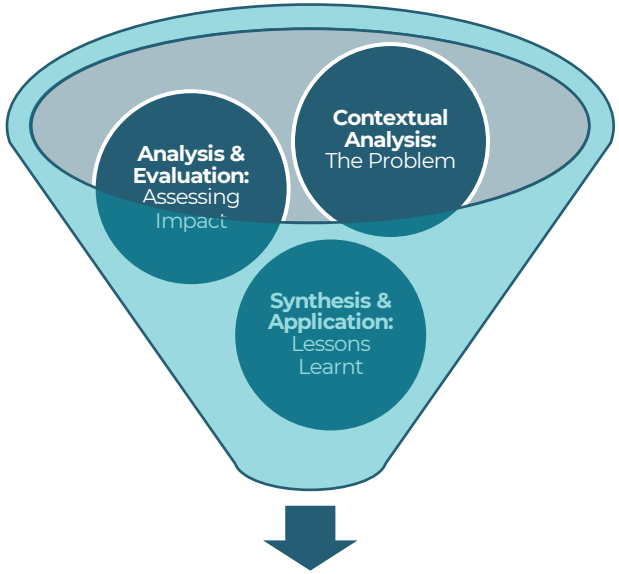


Case Studies:
Real-life Applications

Importance of Case Studies:

1. Gaining practical knowledge by analysing real- life applications that offer tangible examples that reinforce theoretical concepts
2. Developing problem- solving skills to understand the implementation process of sustainable aviation technologies and practices
3. Analysing the environmental, economic and social impacts of sustainability initiatives as well as identifying viable strategies and practices for overcoming industry challenges

Three-point Case Study Analysis Methodology:



Comprehensive Understanding & Actionable Insights

INJAZ Al-Arab
Member of JA Worldwide

Sustainable Technologies:
Airline

Case Study #1: Middle East Airlines

Fleet Modernisation: Airbus A321neo

(Source: AIRBUS)

(Source: Pratt & Whitney)

Contextual Analysis

- MEA upgrades fleet to include the new A321neo aircraft
- Operational need for fuel efficient aircrafts aligning with sustainability goals

Synthesis & Evaluation:

- Aerodynamic-enhancing sharklets on the wings
- PW1100 PurePower fuel efficient engines
- 30% overall fuel and CO_2 savings per seat
- Certified for 50% Sustainable Aviation Fuel blend usage for future implementation

INJAZ Al-Arab

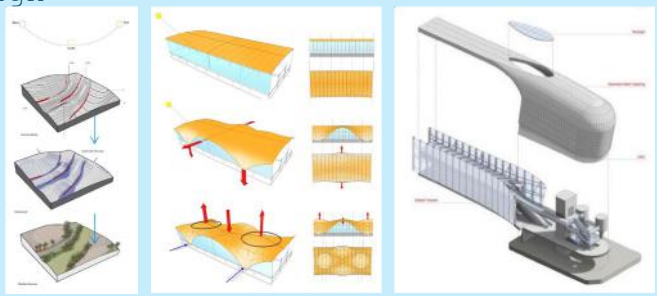
Member of JA Worldwide

Sustainable Technologies:
Airport

Case Study #2: Zayed International Airport (Abu Dhabi)

Airport Terminal Eco- Design

(Source: DIP)



(Source: ICAO)

Contextual Analysis

- Airport serves millions of passengers annually
- Industry facing challenges to reduce environmental impact and improve energy efficiency

Synthesis & Evaluation:

- Improved and efficient utilization of HVAC systems and PV cells (active design)
- Enhanced ventilation and shading through façade technologies; inspired by sand dunes (passive design)
- Reduction of 14.5% overall energy use

INJAZ Al-Arab

Member of JA Worldwide

Sustainable Operations Practices:
Airport

Case Study #3: Rajiv Gandhi International Airport

Ground Handling and Operations Electrification

(Source: Clean India Journal)

(Source: ACI)

Contextual Analysis

- Airport serves millions of passengers annually
- Efforts to maintain good local air quality and minimize carbon emissions and noise levels

Synthesis & Evaluation:

- Continuous climb and decent flight paths and fixed ground electrical power measures saved 40-50% fuel consumption
- Electrical ground support equipment and transportation lowered air pollution levels as well as a green belt of plants absorbing 265 tonnes of CO_2 annually

INJAZ Al-Arab

Member of JA Worldwide

Sustainable Operations Practices:
Airline

Case Study #4: Qatar Airways

Waste and Water Management

(Source: Qatar Airlines)

(Source: Aero EXPO)

Contextual Analysis

- Airline operations and catering services in specific generate a large amount of waste
- Qatar Airlines introduced waste mitigation initiatives

Synthesis & Evaluation:

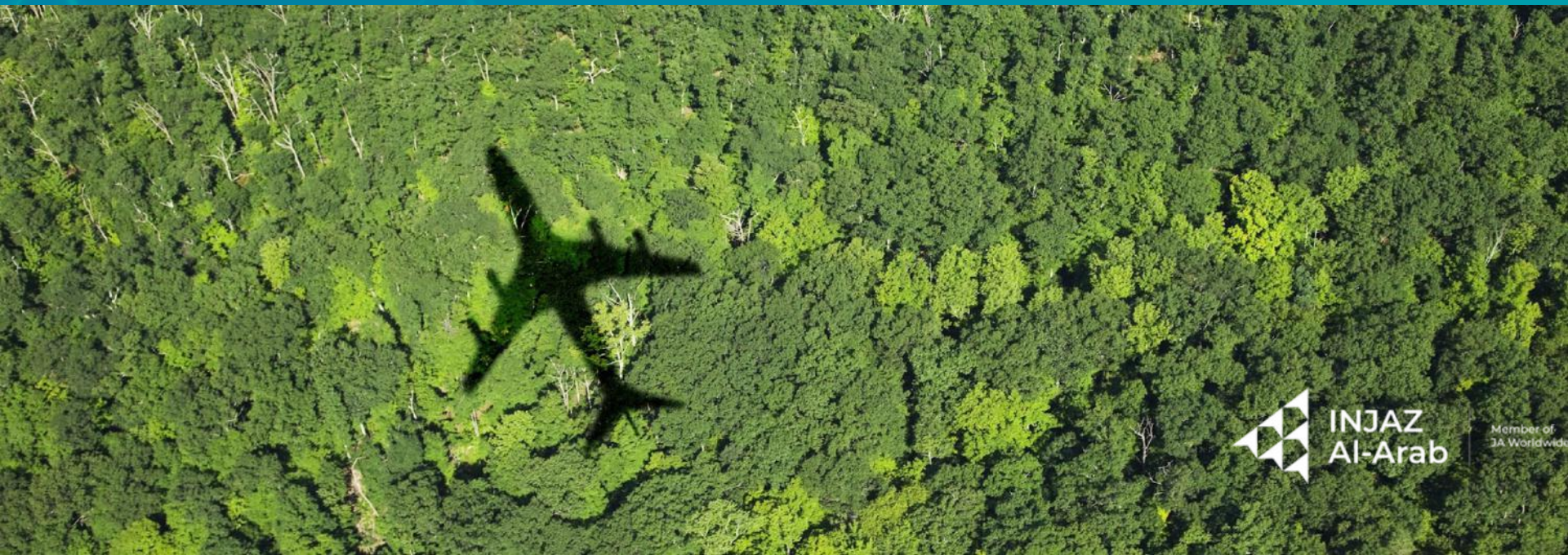
- Increased use of recyclable and biodegradable products by 80%
- Recycled over 1,000 tons of packaging materials, 52 tons of magazines, and 5,000 gallons of cooking oil
- Donating 200-300kg of food daily to charity

INJAZ Al-Arab

Member of JA Worldwide

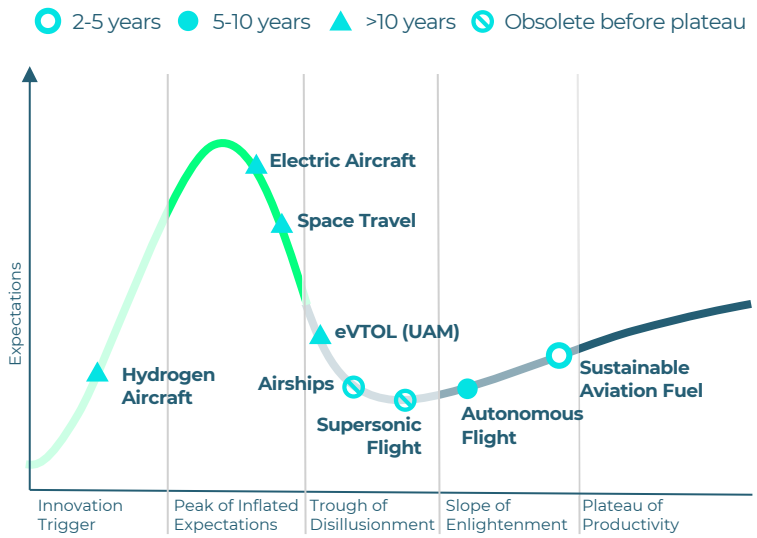
Objective 2.3:

Innovation & Sustainable Aviation



Aviation Sustainability: *the future*

Aviation Technology Innovation Roadmap



Source: TNMT

Innovation Trigger:
Early stages of development and inception but promising viability

Peak of Inflated Expectations:
Long way ahead of technological development to make it viable

Trough of Disillusionment:
Technological hurdles impeding market readiness

Slope of Enlightenment:
Increasing rapidly interest and R&D underway with promising results

Plateau of Productivity:
Market ready and developed innovation

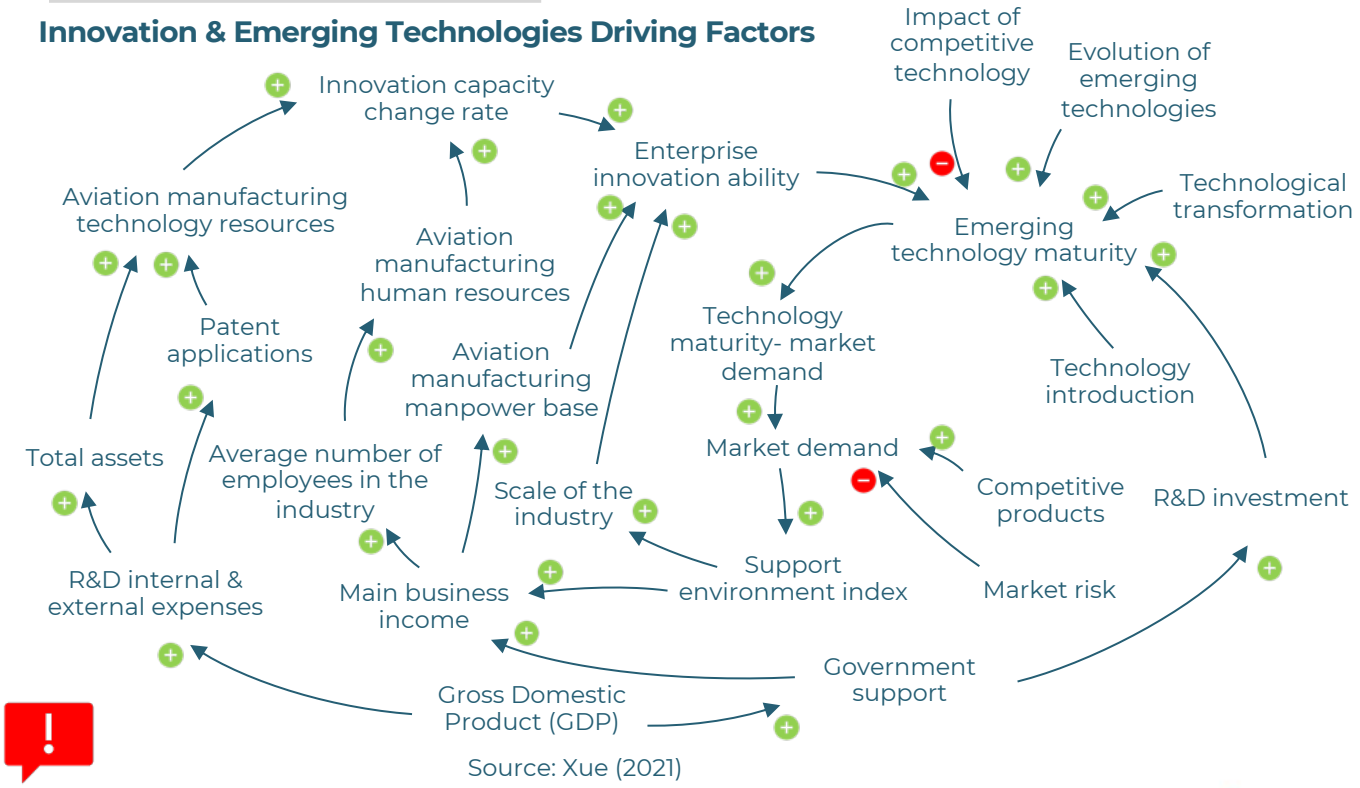
INJAZ Al-Arab
Member of JA Worldwide

Aviation Sustainability: *the future*

DO

Can you think of other inhibiting (⊖) relationships and how do they affect other factors negatively?

Innovation & Emerging Technologies Driving Factors

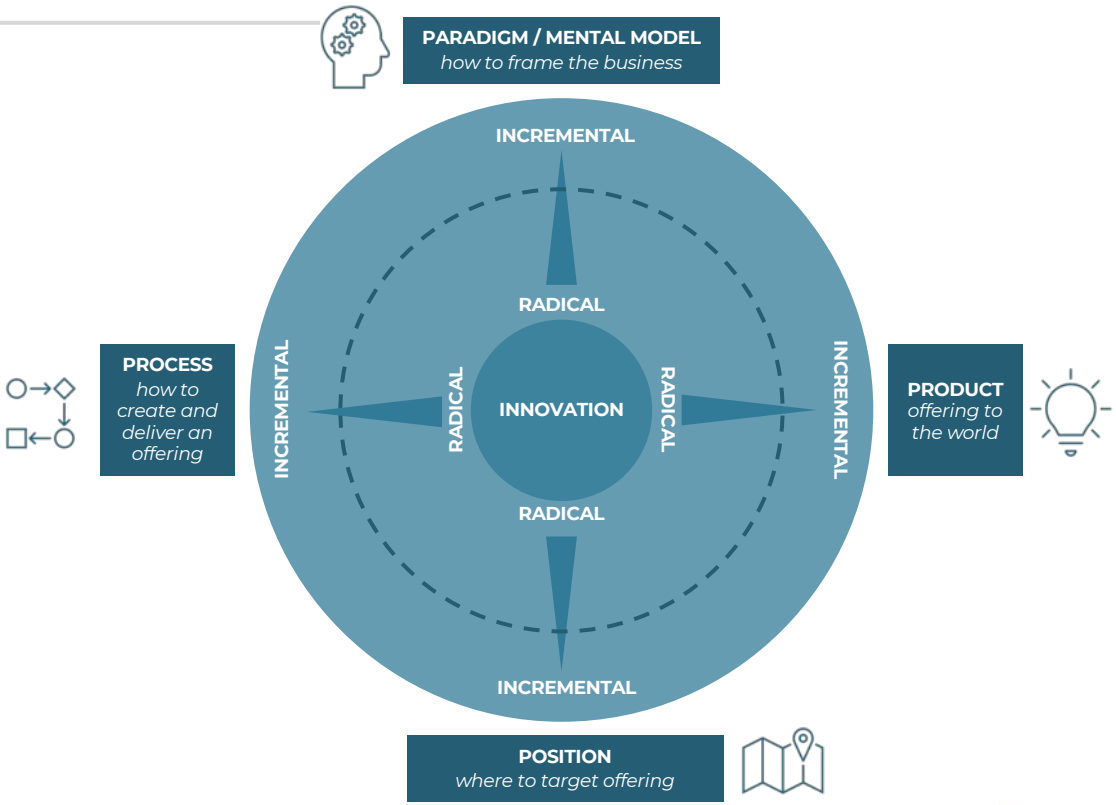


Source: Xue (2021)

INJAZ Al-Arab

Member of JA Worldwide

Aviation Sustainability:
Innovation



INJAZ Al-Arab

Member of JA Worldwide

Innovative Ideas:
Propulsion

Innovative Propulsion Technologies

Hydrogen Powered

Source: AIRBUS

Electrical Aircrafts

Source: EE NEWS

INJAZ Al-Arab
Member of JA Worldwide

Innovative Ideas:
Urban Air Mobility (eVTOL)

Source: Urban Air Mobility (UAM)Urban-Air Port

INJAZ Al-Arab
Member of JA Worldwide

Innovative Ideas: *Inmarsat (IRIS)*

Source: Aviation Today

Source: Inmarsat

INJAZ Al-Arab
Member of JA Worldwide